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(54) Elevator with counterweight

(57) An elevator comprising an elevator shaft (1) with guide rails on which the elevator car (2) and its counterweight (3) move, the ropes (4) on which the car and counterweight are suspended, and a traction sheave (5), whose motion is transmitted to the car and counterweight by the ropes (4). To increase the transportation capacity of the elevator in relation to the shaft volume, the rail length provided for the travel of the counterweight (3) is shorter than the rail length provided for the travel of the elevator car (2). The counterweight (3) may be very thin and 5-8 m high.

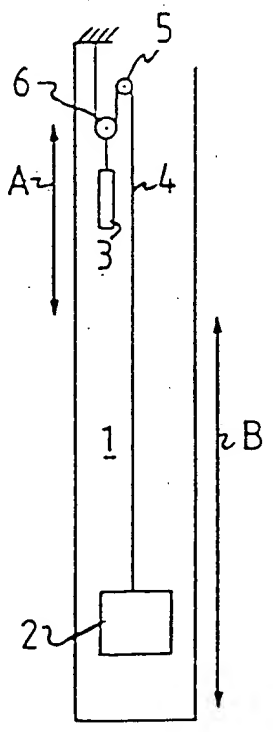

Fig4

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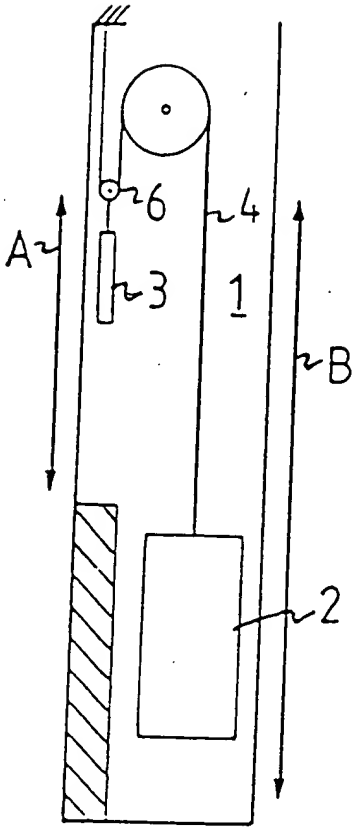

Fig.1

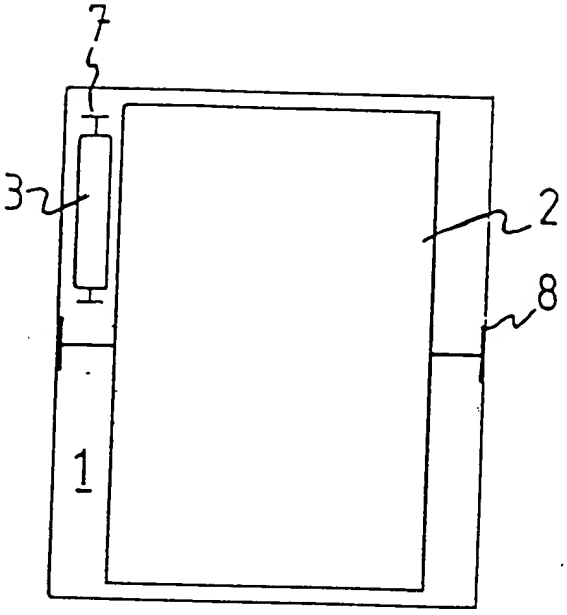

Fig.2

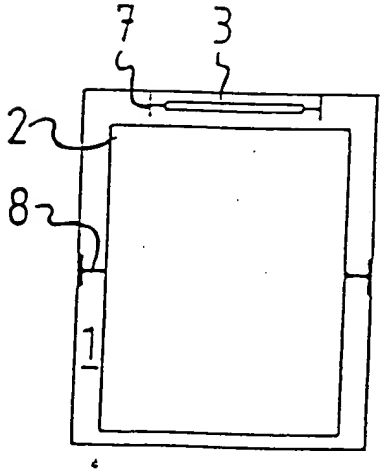

Fig.3

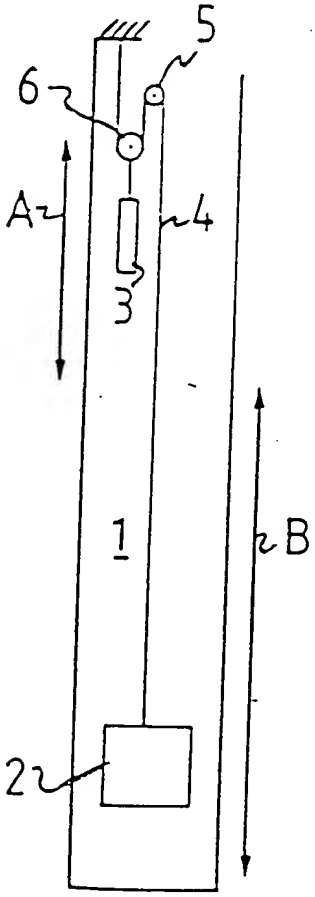

Fig.4

ELEVATOR

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The present invention relates to an elevator comprising an elevator shaft with guide rails on which the elevator car and its counterweight move, the ropes on which the car and counterweight are suspended, and a traction sheave, whose motion is transmitted to the car and counterweight by the ropes.

To increase the transportation capacity of an elevator in relation to the total volume of the elevator structures, an expedient commonly used is to increase the transportation capacity relative to time e.g. by increasing the travelling speed of the elevator or by appropriate arrangements in the organization of elevator traffic, e.g. by shortening the stays at floor levels between stopping and departure.

Another way to increase the transportation capacity in relation to the volume of the elevator structures is to reduce the total volume of the elevator. To achieve a reduction in the total volume, it is hardly possible to reduce the size of the machine room to any signifcant extent. Neither can the height of the elevator shaft be reduced without reducing the travel height or speed of the elevator.

Thus, the only recourse available is to increase the ratio of the area of the horizontal section of the elevator car to the sectional area of the shaft. To achieve this, the layout of the elevator components on the transverse plane in the shaft is generally designed with a view to increasing the car area. In the transverse layout, within the limitations imposed by the functional properties of the components, a nearly optimum state has already been achieved.

Another problem with current elevator suspension arrangements where the counterweight speed and travel are equal to

those of the car is that, in cases of failure where the car and counterweight "break loose", the sudden stop resulting from the action of the safety gear leads to a so-called bound of the counterweight, for which reason the elevator shaft must provide enough headroom for this counterweight bound at the upper end to avoid damage to the machinery or the shaft ceiling.

Another factor which imposes certain restrictions on the design of the elevator shaft is the height of the counterweight, because the counterweight travel is essentially equal to the car travel.

The object of the present invention is to increase the transportation capacity of the elevator in relation to the shaft volume and to eliminate or at least to reduce the counterweight bound referred to above. The invention also aims at providing greater freedom of design regarding the height of the counterweight to facilitate the design of the elevator shaft. This invention, by shortening the travel of the counterweight relative to the travel of the elevator car, reduces the average relative area occupied by the counterweight in the transverse section of the elevator shaft while also reducing the proportion of shaft volume required by the counterweight when moving along the guide rails in the shaft.

The elevator of the invention is characterized in that the rail length provided for the travel of the counterweight is shorter than the rail length provided for the travel of the elevator car.

A preferred embodiment of the elevator of the invention is characterized in that the shortened counterweight travel is achieved by using at least one diverter pulley to render the counterweight roping ratio larger than the car roping ratio.

Another preferred embodiment of the elevator of the invention is characterized in that the counterweight travel equals approximately half the travel of the elevator car and that the counterweight moves along a track located in the upper part of the elevator shaft.

Yet another preferred embodiment of the elevator of the invention is characterized in that the counterweight is approx. 5-8 m high and as thin as possible.

The invention offers several advantages over previously known techniques. Among the most important are: A better volume/capacity ratio, i.e. part of the saft space previously occupied by the counterweight can be used for other purposes. Since the guide track is shorter, less material is needed for the rails and rail mounting accessories. Further, a shorter partition meshwork is needed, if applicable. The lower counterweight speed resulting from the shorter travel allows the use of a smaller and cheaper buffer, possibly enabling a spring buffer to be used instead of an oil buffer. Moreover, it is possible to apply a higher limit speed for the use of the tension weights on the compensating ropes because the counterweight bound resulting from the action of the car safety gear is smaller (proportional to the square of the speed). The resulting strain on the gear wheels in the gear assembly is reduced. Also, less headroom for counterweight bound is required.

Further economies are achieved in the installation work, because, due to the shorter guide rail track, there is less to install and it is easier to get the rails aligned. The relative speed at which the elevator car and counterweight meet in the shaft is lower, which means that the pressure impact which causes the car to sway is also reduced. On account of the shorter rail track, the strain imposed on the rails by the deformations, swinging or setting of the

building is reduced. In addition to new buildings, the invention is also applicable to the modernization of old elevators, because it enables the elevator capacity to be increased by as much as 20%.

In the following, the invention is described by the aid of examples of preferred embodiments, reference being made to the drawings attached, wherein:

Fig. 1 presents an embodiment of the elevator of the invention in diagrammatic form, seen from the side.

Fig. 2 presents another embodiment of the elevator of the invention in diagrammatic form, seen from above.

Fig. 3 presents a third embodiment of the elevator or the invention in diagrammatic form, seen from above.

Fig. 4 shows a diagram of a fourth embodiment of the elevator of the invention, seen from the side.

In Fig. 1, the elevator car 2 and the counterweight 3 move along their respective guide rails (not shown) in the elevator shaft 1. The elevator also comprises the suspension ropes 4 supporting the car and counterweight and transmitting the motion from the traction sheave 5 to the car and counterweight. The suspension ropes 4 pass around at least one diverter pulley 6 in such manner that the counterweight roping ratio is larger than the car roping ratio. In this manner, the travel A of the counterweight is shortened and can equal e.g. half the travel B of the car. On account of the shorter counterweight travel, the transportation capacity of the elevator in relation to the shaft volume is increased. The increased capacity can be utilized in many ways. In the case of the embodiment in Fig. 1, in which arrow A indicates the range of movement of the counterweight and arrow B the range of movement of the elevator

car, the shaft space thus left free below the counterweight track can be used for other purposes in the building.

In the embodiment in Fig. 2, the counterweight, which moves along guide rails 7, is located at the side of the elevator car 2, which moves along guide rails 8. Because spaces must be provided for the automatic doors at the sides of the car, the counterweight can also be placed in this space. The counterweight in this embodiment is narrower than usual but its height has been increased correspondingly, which is possible because the counterweight travel is shorter than the car travel.

Fig. 3 shows an embodiment in which the counterweight is as thin as possible but also considerably higher than usual, e.g. about 5-8 m. This makes it possible to increase the depth dimension of the elevator car.

Fig. 4 shows an embodiment in which the counterweight track A is entirely above the car track B. Such an arrangement is especially suited for elevators serving a "low zone" and having their machine room higher up in the building. Thus the counterweight takes up no shaft space at all within the territory of the car 2. This allows the size of the car to be increased or the space reserved for the counterweight to be used for other purposes in the building. The buffer of the counterweight is placed on a steel beam in the shaft.

It is obvious to a person skilled in the art that the invention is not restricted to the examples of its embodiments described above, but that it may instead be varied within the scope of the following claims.

CLAIMS

1. Elevator comprising an elevator shaft (1) with guide rails (7, 8) on which the elevator car (2) and its counterweight (3) move, the ropes (4) on which the car and counterweight are suspended, and a traction sheave (5), whose motion is transmitted to the car and counterweight by the ropes (4), c h a r a c t e r i z e d in that the rail (7) length provided for the travel of the counterweight (3) is shorter than the rail (8) length provided for the travel of the elevator car (2).

2. Elevator according to claim 1, c h a r a c t e r - i z e d in that the shortened travel of the counterweight (3) is achieved by using at least one diverter pulley (6) to render the roping ratio of the counterweight (3) larger than the roping ratio of the car (2).

3. Elevator according to claim 1 or 2, c h a r a c t e r - i z e d in that the travel (A) of the counterweight (3) equals approximately half the travel (B) of the elevator car (2) and that the counterweight moves along a track located in the upper part of the elevator shaft (1).

4. Elevator according to any one of the claims 1 -3, c h a r a c t e r i z e d in that the counterweight (3) is approx. 5-8 m high and as thin as possible.

5. Elevator according to any one of the claims 1 -3, c h a r a c t e r i z e d in that the track (A) of the counterweight (3) is entirely above the track (B) of the elevator car (2).

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